Type of Alcoholic Drink and Risk of Major Coronary Heart Disease Events and All-Cause Mortality

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ABSTRACT

Objectives. This study examined the effects of beer, spirits, and wine drinking on coronary heart disease (CHD) events (fatal and nonfatal) and all-cause mortality.

Methods. Men aged 40 to 59 years (n = 7735) were drawn at random from one general practice in each of 24 British towns and followed up for an average of 16.8 years.

Results. Regular drinkers showed a significantly lower relative risk of CHD, but not all-cause mortality, than occasional drinkers, even after adjustment for potential confounders. The benefit for CHD of regular drinking was seen within both beer drinkers and spirit drinkers but not among men who reported wine drinking. However, all men who reported wine drinking (both occasional and regular) showed significantly lower age-adjusted risks of CHD and all-cause mortality than men drinking beer or spirits; beer and spirit drinkers showed similar risks.

Conclusions. The findings suggest that regular intake of all alcoholic drinks is associated with a lower risk of CHD, but not all-cause mortality, than occasional drinking. A large part, but not all, of the greater benefit seen in wine drinkers relative to other drinkers can be attributed to advantageous lifestyle characteristics (e.g., low rates of smoking and obesity). (*Am J Public Health.* 1999;89:685–690)

Light and moderate drinking has consistently been associated with lower risk of coronary heart disease (CHD).[1–4] Several studies have suggested that specific types of drink may have different effects on CHD and, in particular, that the protective effect is derived only from wine drinking or that wine consumption is most beneficial.[5,6] The question of whether wines contain components that may confer additional benefits relative to other alcoholic beverages has been raised in recent years. Several studies have suggested a possible role of antioxidants[7,8] and of antithrombotic and platelet activity in wine.[9,10] A recent systematic review of ecological, case–control, and prospective studies concluded that all alcoholic drinks were linked with a lower risk of CHD, but there was no consensus that wine drinking was most beneficial.[11] In many of the study populations reviewed, there was little variation in type of drink, alcoholic drinks being limited to 1 or 2 types.

Relatively few investigations have been able to compare the effects of different types of drink within the same study population, and their findings have not been consistent.[12–18] The importance of lifestyle, behavioral, and drinking patterns associated with beverage type has been emphasized in examining the differential effects.[11]

In this article, data from the British Regional Heart Study, a prospective study of 7735 middle-aged men, are used to examine the relationships between beer, spirit, and wine drinking and risk of major CHD events and all-cause mortality. Analyses took into account differences in lifestyle and personal characteristics associated with beverage type.

Methods

Subjects

The British Regional Heart Study is a prospective investigation of cardiovascular disease involving 7735 men aged 40 to 59 years selected from the age–sex registries of one group general practice in each of 24 towns in England, Wales, and Scotland. The criteria for selecting the town, the general practice, and the subjects, as well as the methods of data collection, have been reported elsewhere.[19] Men with preexisting cardiovascular disease and those undergoing regular medical treatment were not excluded. The only individuals excluded were those regarded by their doctors as physically or psychologically unable to participate (about 2% in each practice).

During 1978 through 1980, research nurses administered to each man a standard questionnaire including questions on smoking habits, alcohol intake, and medical history. Several physical measurements were made, and blood samples (nonfasting) were taken for assessment of biochemical and hematological variables. Details of the measurement of blood pressure and blood lipids have been reported elsewhere.[19,20] The men were asked to recall whether a doctor had ever told them that they had angina or myocardial infarction (heart attack, coronary thrombosis), stroke, and a number of other disorders. Because of the strong influence that a diagnosis of CHD or stroke is known to have on drinking patterns,[21] and because of the associated high rates of both CHD and all-cause mortality, we excluded from analyses the 456 men with recall of a doctor diagnosis of CHD or stroke. In addition, 7 men who did not provide information on alcohol

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intake or type of drink were excluded, leaving 7272 men for analysis.

Alcohol Intake

Questions on frequency, quantity, and type similar to those used in the 1978 General Household Survey[22] were used in recording alcohol consumption at the initial screening. The men were questioned about frequency (none, occasional, weekend, or daily) and quantity (1–2, 3–6, or more than 6 drinks per day) of alcohol intake, leading to the following drinking categories: nondrinkers, occasional drinkers (special occasion or 1–2 drinks per month), weekend drinkers (1–2, 3–6, or more than 6 drinks per weekend day), and men drinking daily or on most days (1–2, 3–6, or more than 6 drinks per day).[23] These categories were the only choices provided. It should be noted that "more than 6 drinks per day" is an open-ended category.

The men were classified into 5 groups according to their estimated reported weekly intake: none, occasional (less than 1 unit per week), light (1–15 units per week), moderate (16–42 units per week), and heavy (more than 6 units per day). One UK unit of alcohol (1 drink) is defined as half a pint of beer, a single measure of spirits, or a glass of wine (approximately 8–10 g alcohol). Heavy drinking refers to those consuming more than 6 drinks daily or most days. Twenty-five biochemical and hematological measurements on a single blood sample taken at the time the questionnaire was completed indicated that the reported levels of alcohol consumption were valid on a group basis.[24]

Type of Drink

The men were asked to indicate which type of drink they usually consumed: (1) beer (n = 4101), (2) spirits (n = 741), (3) mixed beer and spirits (n = 983), (4) wine/sherry (n = 500), or (5) mixed wine and sherry, beer, and spirits (n = 535).

Confounding Factors

Details of classification methods for smoking status, social class, and physical activity have been reported elsewhere.[19,25] The longest-held occupation of each man was recorded and then coded, in accordance with the registrar general's occupational classification, into 1 of 6 social classes: I, II, III nonmanual, III manual, IV, and V. Men who had spent most of their working life in the armed forces formed a separate group. For some analyses, those in social classes I, II, and III nonmanual were combined as nonmanual workers, and those in social classes III manual, IV, and V were combined as manual workers.

The men were classified into 6 physical activity groups on the basis of their leisure-time activities: inactive, occasional, light, moderate, moderately vigorous, and vigorous. "Active" men were defined as those who were engaged in at least moderate levels of physical activity. Obesity was defined as a body mass index of 28 kg/m^2 or more (which represents the upper fifth of the body mass index distribution of all men). Forced expiratory volume in 1 second was measured, with a vitalograph spirometer, while participants were in a seated position, and values were standardized for height.

Questionnaire Evidence of CHD

The World Health Organization (WHO) chest pain questionnaire[26] was administered to all men at the initial examination. Evidence of CHD was provided by questionnaire responses indicating angina or a possible myocardial infarction.

Follow-Up

All men, whether or not they showed evidence of CHD at the initial examination, were followed up for all-cause mortality and cardiovascular morbidity.[27] All major CHD events (fatal and nonfatal heart attacks and sudden cardiac death) and all deaths occurring in the period up to December 1995 were recorded; the average follow-up period was 16.8 years (range: 15.5–18.0 years), and follow-up was achieved for 99% of the cohort. Information on death was collected through established "tagging" procedures provided by the National Health Service registries in Southport (England and Wales) and Edinburgh (Scotland). Fatal CHD events were defined as deaths with CHD (*International Classification of Diseases, Ninth Revision,* codes 410–414) as the underlying cause. A nonfatal myocardial infarction was diagnosed according to WHO criteria, which included any report of myocardial infarction accompanied by at least 2 of the following: history of severe chest pain, electrocardiographic evidence of myocardial infarction, and cardiac enzyme changes associated with myocardial infarction.[28] Information on nonfatal events was ascertained by (1) reports from general practitioners, (2) postal questionnaires at 5 years after screening and in 1992, and (3) biennial reviews of each man's general practice records, including hospital and clinic correspondence.

Statistical Analysis

Cox's proportional hazards model was used to assess, after adjustment for potential confounders, the relationship between alcohol intake and type of beverage and risk of major CHD events and mortality.[29] In the adjustments, the following were fitted as categorical variables: social class (I, II, III nonmanual, III manual, IV, V, and armed forces), smoking (never, ex-smoker, 1–19 cigarettes per day, 20 cigarettes per day, more than 20 cigarettes per day), physical activity (none, occasional, light, moderate, moderately vigorous, vigorous), questionnaire evidence of CHD (yes/no), regular medication (yes/no), diabetes (yes/no), area of residence (south, midlands, north, Scotland), and amount of alcohol consumed (occasional, light, moderate, heavy). Age, forced expiratory volume, and body mass index were fitted as continuous variables. Direct standardization was used to obtain age-adjusted rates; the study population was used as the standard.

Results

During the mean follow-up period of 16.8 years, there were 901 major CHD events (456 nonfatal, 445 fatal), representing a rate of 8.3 per 1000 person-years. There were 1308 deaths from all causes (595 cardiovascular and 713 noncardiovascular) in the 7272 men with no diagnosis of CHD or stroke, a rate of 11.6 per 1000 person-years.

Alcohol Intake and Risk

Table 1 shows a U-shaped relationship between alcohol intake and age-adjusted major CHD events and all-cause mortality, with the lowest rates seen in light drinkers. In this cohort, nondrinkers have been shown to be an inappropriate baseline group for studying the effects of alcohol on health and disease[30,31]; thus, we used occasional drinkers, a large and relatively stable group, as the baseline category. In addition, alcohol intake is associated with many of the established risk factors for cardiovascular disease and may be influenced by ill health. We therefore adjusted the relative risks (RRs) for age, smoking, social class, physical activity, and body mass index, as well as for indicators of disease (namely, diabetes, questionnaire evidence of CHD, and regular medication).

After adjustment, there was virtually no difference in the relative risk of CHD or all-cause mortality between the light, moderate, and heavy drinkers. Regular drinkers (combined) showed a significantly lower risk for major CHD events than occasional drinkers

TABLE 1—Alcohol Intake at Screening and Adjusted Relative Risks (RRs) of Major Coronary Heart Disease (CHD) Events and All-Cause Mortality: 7272 Men With No Diagnosis of CHD or Stroke Over a Mean Follow-Up of 16.8 Years

	Major CHD Events[a]				Total Mortality[b]			
Alcohol Intake (No.)	No.	Rate/1000 Person-Years	Age-Adjusted RR	Adjusted RR[c] (95% CI)	No.	Rate/1000 Person-Years	Age-Adjusted RR	Adjusted RR[c] (95% CI)
None (412)	66	10.3	1.10	1.03 (0.78, 1.37)	96	13.9	1.19	1.09 (0.86, 1.38)
Occasional (1726)	242	9.5	1.00	1.00 ...	313	11.8	1.00	1.00 ...
Light (2398)	251	6.7	0.71	0.76 (0.64, 0.91)	374	9.6	0.81	0.88 (0.76, 1.02)
Moderate (1945)	239	8.4	0.88	0.78 (0.65, 0.94)	367	12.4	1.06	0.92 (0.79, 1.08)
Heavy (791)	103	9.3	0.98	0.75 (0.59, 0.95)	158	14.1	1.21	0.89 (0.73, 1.09)

[a]Regular vs occasional drinkers: RR = 0.77 (95% CI = 0.66, 0.90; $P = .0008$).
[b]Regular vs occasional drinkers: RR = 0.90 (95% CI = 0.79, 1.02; $P = .11$).
[c]Adjusted for age, social class, smoking, physical activity, body mass index, lung function, evidence of CHD on questionnaire, diabetes, and regular medication.

(RR = 0.77, 95% confidence interval [CI] = 0.66, 0.90). Additional adjustment for high-density lipoprotein (HDL) cholesterol raised the relative risk for CHD events to 0.83 (95% CI = 0.71, 0.98), but it remained statistically significant ($P < .05$). For all-cause mortality, nondrinkers had the highest (albeit nonsignificant) risk, and there was no significant difference in the risk of all-cause mortality between regular drinkers (combined) and occasional drinkers.

Type of Drink and Risk

To determine whether the lower risk of CHD observed with regular drinking than with occasional drinking depended on the type of alcohol consumed, we examined the relationship between regular drinking and major CHD events and all-cause mortality separately by the 5 mutually exclusive alcohol categories (beer, spirits, beer and spirits, wine, and mixed wine, beer, and spirits). Table 2 shows that within the 3 nonwine categories, regular drinkers exhibited a significantly lower risk of major CHD events than occasional drinkers after adjustment for confounders. Among both groups of men who reported drinking wine, no apparent benefit was derived from regular drinking. For all-cause mortality, there was little difference in adjusted relative risk between occasional and regular drinkers within all 5 drinking categories (Table 2). However, men who reported wine drinking (both occasional and regular drinkers) had lower age-adjusted absolute rates of both major CHD events and all-cause mortality than those reporting no wine drinking (beer, spirit, and mixed beer/spirit drinkers).

Wine Drinking

To determine whether wine drinking (vs consumption of beer and spirits) conferred any benefit in terms of risk of CHD events or all-cause mortality, we compared the effects of the different types of drink in occasional and regular drinkers using beer drinkers as the reference group (Table 3). Because of our interest in assessing the specific effects of wine, and because all men who reported drinking wine showed similar low risks, we combined all men who reported any regular wine drinking. All men who drank spirits were similarly combined, and 3 mutually exclusive categories were used: (1) those who drank only beer (n = 4101); (2) those who drank spirits, including those who drank beer as well but not wine (n = 1724); and (3) those who drank wine (including those who consumed all types of beverages) (n = 1035). Men who reported wine drinking showed significantly lower rates of major CHD events than beer drinkers, as well as lower rates for all-cause, cardiovascular, and noncardiovascular mortality. Spirit drinkers exhibited rates similar to those of beer drinkers.

However, wine drinkers in this study possessed several advantageous characteristics (Table 4). They were predominantly nonmanual workers, had the lowest rate of current smoking and obesity, and were more likely to be physically active and to be light drinkers. Furthermore, they were less likely to drink heavily when they drank and were more likely to live in the southern part of the country, which has the lowest mortality rates.[32] They also had better lung function (forced expiratory volume) and reported a lower prevalence of CHD. When these characteristics were examined for the original 5 alcohol groups, wine/sherry drinkers were virtually identical to mixed wine/sherry, beer, and spirit drinkers (data not shown). Adjustment for these baseline characteristics markedly attenuated the decreased risk of CHD associated with wine drinking relative to beer drinking, and the difference was no longer significant. For all-cause mortality, the decreased risk was also markedly reduced, but wine drinking remained associated with a significant reduction even after adjustment, largely as a result of a lower risk of cardiovascular disease mortality. After adjustment, there was a small but nonsignificant reduction for noncardiovascular mortality (Table 3).

When examined separately for fatal (n = 411) and nonfatal (n = 425) CHD events, wine drinking (as compared to beer drinking) showed a slightly greater reduction for fatal events than for nonfatal events after adjustment, although neither of these findings were significant (adjusted RR = 0.84, 95% CI = 0.61, 1.17, for nonfatal events and RR = 0.78, 95% CI = 0.54, 1.10, for fatal events).

Wine drinkers showed HDL cholesterol levels identical to those of beer and spirits drinkers, and indeed HDL cholesterol increased at the same rate with increasing alcohol intake in wine, beer, and spirits drinkers (data not shown). Wine drinkers had slightly higher serum total cholesterol concentrations and significantly lower systolic blood pressures. Further adjustment for total cholesterol and systolic blood pressure resulted in minor differences in the relationships seen, although the association with cardiovascular disease mortality became of marginal significance (RR = 0.74, 95% CI = 0.54, 1.01, $P = .06$).

Restricting Alcohol Categories

The pattern of relationship between alcohol type and outcome (Table 3) was similar but weaker when the analyses were restricted to men who drank only spirits (n = 741) and only wine/sherry (n = 500) (i.e., not including men who drank mixed beverages). The adjusted relative risks for major CHD events were 1.14 and 0.87 for spirit drinkers and wine drinkers only; the corresponding relative risks were 1.06 and 0.93 for all-cause mortality and 1.01 and 0.84 for cardiovascular disease mortality. Men who drank mixed beverages excluding wine (n = 983) showed similar risks of CHD and

TABLE 2—Alcohol Intake and Adjusted Relative Risks (RRs) for Major Coronary Heart Disease (CHD) Events and All-Cause Mortality, by Type of Drink (n = 6860 men)

Type of drink	No.	Major CHD Events: No. of Cases	Major CHD Events: Rate/1000 Person-Years	Major CHD Events: Adjusted RR[a] (95% CI)	Total Mortality: No. of Deaths	Total Mortality: Rate/1000 Person-Years	Total Mortality: Adjusted RR[a] (95% CI)
Beer							
Occasional drinkers	833	112	9.4	1.00 ...	162	13.1	1.00 ...
Regular drinkers	3268	385	8.0	0.78 (0.63, 0.97)	601	12.2	0.84 (0.71, 1.01)
Spirits							
Occasional drinkers	290	59	13.6	1.00 ...	65	13.9	1.00 ...
Regular drinkers	451	55	7.9	0.57 (0.39, 0.85)	87	11.7	0.86 (0.61, 1.21)
Mixed beer and spirits only							
Occasional drinkers	227	37	10.8	1.00 ...	39	11.2	1.00 ...
Regular drinkers	756	94	8.0	0.75 (0.50, 1.10)	138	11.0	1.00 (0.69, 1.44)
Wine							
Occasional drinkers	238	23	6.0	1.00 ...	31	7.7	1.00 ...
Regular drinkers	262	25	5.8	0.92 (0.51, 1.67)	34	7.6	0.87 (0.51, 1.48)
Mixed wine/sherry, beer, and spirits							
Occasional drinkers	138	11	5.3	1.00 ...	16	7.5	1.00 ...
Regular drinkers	397	34	5.7	1.23 (0.54, 2.79)	39	6.6	1.09 (0.55, 2.14)

Note. Within each category, occasional drinkers were the reference group. CI = confidence interval.
[a]Adjusted for age, social class, smoking, physical activity, body mass index, lung function, evidence of CHD on questionnaire, diabetes and regular medication.

cardiovascular disease mortality to beer and spirits drinkers, while those who drank wine and other beverages (n = 535) resembled those who drank only wine in having the lowest risk of both CHD events and cardiovascular disease mortality (RR = 0.77 and RR = 0.56, respectively). Although none of these risks were statistically significant, possibly because of the small numbers involved, both groups of wine drinkers showed a consistently lower risk of CHD events and cardiovascular disease mortality than beer drinkers.

Discussion

The inverse relationship between total alcohol intake and risk of CHD is well established, but findings on the protective effects of specific types of alcoholic beverage have been conflicting. In a recent review of studies that have examined the relation between specific alcoholic drinks and risk of CHD, including 10 prospective cohort studies and 3 case–control studies, no consistent pattern emerged for specific types of drink, and it was concluded that alcohol itself, rather than a particular type of drink, is responsible for the reduction in risk.[11] The present data from the British Regional Heart Study provide further evidence that all alcoholic drinks are linked with lower risk of CHD. Regular drinkers showed a significantly lower risk of major CHD, but not all-cause mortality, than occasional drinkers. The lower risk of major CHD associated with regular drinking was seen among both beer and spirit drinkers but was not apparent in wine drinkers. However, men who drank wine even occasionally had considerably lower absolute risks of CHD and of all-cause mortality than beer and spirit drinkers. A lack of association between alcohol intake and risk of CHD in men who report wine drinking has been observed in several other prospective studies[18,33] and may relate to the low absolute risk in such men. This suggests that the benefits of regular alcohol intake are minimal in men who are already at low risk of CHD or all-cause mortality.

Wine vs Other Types of Alcohol

While there is strong evidence to suggest that all alcoholic drinks are linked with a lower risk of CHD, the issue of whether any specific type of beverage, most notably wine, is more cardioprotective is still uncertain. Evidence that wine is most effective in reducing risk of CHD has come largely from ecological studies; such studies have considerable limitations because they are based on population drinking habits and not on individuals.[5,6] In many cohort studies, drinks are limited to 1 or 2 types of alcohol, and few prospective studies have compared the CHD and mortality risks of beer, spirits, and wine drinkers within the same population. Among those that have, some have found little or no difference in the effects of beer, spirits, and wine on CHD,[13,15] while others (the Framingham and Copenhagen studies) have suggested wine to be most protective.[14,17]

In the Kaiser Permanente Study, no difference in relationship was observed between beverage choice (beer, spirits, and wine) and risk of coronary artery disease hospitalization,[15] but there was a lower risk of CHD mortality and cardiovascular mortality in wine drinkers than in spirit drinkers.[16] Also, wine drinkers had more favorable traits than spirit drinkers.[16] These findings are very similar to those of the British Regional Heart Study. In contrast, some studies have found beer[12] or spirits[33] to be most protective. However, no information was provided on the proportions, characteristics, or absolute risks among the different beverage groups in these population studies.

It has been suggested that differences in findings regarding specific types of drinks, particularly the low risk seen in wine drinkers relative to other drinkers, may be the result of differences in patterns of drinking and to differences in risk traits between those choosing different beverages.[11] In this cohort of British middle-aged men, about 15% reported wine drinking, and these men had many beneficial characteristics. In particular, they were from higher socioeconomic backgrounds, they were more likely to be light drinkers, and they had more favorable lifestyle patterns than beer and spirit drinkers. These beneficial characteristics were, to a considerable degree, responsible for the lower relative risk of CHD and mortality in wine drinkers than in beer drinkers, although there remained a significant reduction in

TABLE 3—Type of Alcoholic Drink and Risk of Major Coronary Heart Disease (CHD) Events and of All-Cause, Cardiovascular, and Noncardiovascular Mortality: Occasional and Regular Drinkers (n = 6860 men)

	Beer (n = 4101)	Spirits (n = 1724)	Wine (n = 1035)
Major CHD events			
Cases	497	245	93
Age-adjusted rate/1000 person-years	8.3	9.2	5.8
Age-adjusted RR (95% CI)	1.00 ...	1.12 (0.96, 1.30)	0.69 (0.56, 0.87)
Adjusted RR[a] (95% CI)	1.00 ...	1.07 (0.90, 1.26)	0.82 (0.64, 1.04)
All-cause mortality			
Cases	763	329	120
Age-adjusted rate/1000 person-years	12.4	11.7	7.3
Age-adjusted RR (95% CI)	1.00 ...	0.94 (0.83, 1.07)	0.58 (0.47, 0.70)
Adjusted RR[a] (95% CI)	1.00 ...	0.98 (0.85, 1.12)	0.80 (0.65, 0.98)
Cardiovascular mortality			
Cases	339	161	50
Age-adjusted rate/1000 person-years	5.4	6.0	3.0
Age-adjusted RR (95% CI)	1.00 ...	1.04 (0.86, 1.25)	0.54 (0.40, 0.73)
Adjusted RR[a] (95% CI)	1.00 ...	1.02 (0.83, 1.25)	0.71 (0.52, 0.98)
Noncardiovascular mortality			
Cases	424	168	70
Age-adjusted rate/1000 person-years	6.8	6.0	4.2
Age-adjusted RR (95% CI)	1.00 ...	0.86 (0.72, 1.03)	0.61 (0.47, 0.78)
Adjusted RR[a] (95% CI)	1.00 ...	0.94 (0.78, 1.14)	0.87 (0.66, 1.14)

Note. Beer drinkers were the reference group. CI = confidence interval.
[a]Adjusted for age, amount drunk, social class, smoking, physical activity, body mass index, region of residence, evidence of CHD on questionnaire, diabetes, lung function, and regular medication.

TABLE 4—Personal, Lifestyle, and Biological Characteristics at Screening, by Different Types of Drinking

Characteristic	Beer	Spirits	Wine
Mean age, y	49.7	50.5	50.0
Current smoker, %	45.2	42.7	24.9
Manual work, %	66.6	48.4	28.6
Obese, %	19.6	20.0	15.1
Active, %	36.9	39.6	42.2
Inactive, %	8.6	8.4	6.1
Heavy drinker, %	13.9	9.9	5.1
Heavy weekend drinker, %	19.2	13.0	3.0
Light drinker, %	33.3	34.9	41.8
Town of residence in the south, %	25.8	31.0	45.0
Mean lung function	3.31	3.33	3.49
Coronary heart disease on questionnaire, %	9.5	11.8	9.1
Recall of high blood pressure, %	11.9	12.1	10.4
Diabetes, %	1.2	1.6	1.4
Mean systolic blood pressure, mm Hg	145.9	145.1	141.9
Mean cholesterol, mmol/L	6.27	6.30	6.33
Mean HDL cholesterol, mmol/L	1.17	1.17	1.17

all-cause mortality largely resulting from cardiovascular causes.

Misclassification

Although many of the subjects tended to consume 2 or 3 types of drink, the lower risk of mortality in wine drinkers than in beer and spirits drinkers in the present study is unlikely to be the result of misclassification; exclusion of men who drank mixed beverages did not appreciably alter the pattern of relationships. Although we used alcohol intake assessed at baseline, the findings are unlikely to be greatly affected by misclassification taking place between occasional and regular drinking status during follow-up. We have shown that the majority of regular drinkers at baseline (68% of light, 78% of moderate, and 89% of heavy drinkers) remained regular drinkers, although there was a general tendency among these individuals to reduce the quantity of alcohol consumed.[21]

Confounding

Adjustment in multivariate analyses is unlikely to fully take into account the multiple advantageous lifestyle characteristics of wine drinkers. Furthermore, given that wine drinkers tend to come from a higher socioeconomic background, these men are likely to have other advantages not measured in this and other studies (e.g., healthier diet and better access to health care). It seems likely that the significantly lower risk of all-cause and cardiovascular disease mortality—but not CHD incidence (fatal and nonfatal)—seen in wine drinkers is a consequence of their healthier lifestyle characteristics and higher socioeconomic status rather than the result of a specific benefit of wine. This is consistent with the slightly greater reduction seen for fatal CHD events than for nonfatal events. Indeed, the lower risk of cardiovascular disease was of marginal significance after further adjustment for total cholesterol and systolic blood pressure. However, our data do not preclude the possibility that wine has nonalcoholic components that may confer additional benefits over beer and spirits. Wine has been reported to contain antioxidants[7,8] and substances that have effects on thrombosis.[9,10]

HDL Cholesterol

Various mechanisms, particularly HDL cholesterol, have been proposed to explain the lower CHD risk in light and moderate drinkers. In the present study, HDL cholesterol explained about one third of the effects of regular drinking relative to occasional drinking, which is consistent with other studies involving nondrinkers rather than occasional drinkers as the baseline group.[34–36] Given the biological variability in HDL cholesterol measurements, the unexplained variance may still be the result of residual confounding. Alternatively, other potential mechanisms, including an effect of alcohol on thrombotic factors such as platelet aggregation and fibrinolysis,[37,38] may be operating. HDL cholesterol is unlikely to explain the lower risk of wine drinking, because the relationship between alcohol intake and HDL cholesterol was similar in beer, spirit, and wine drinkers, and wine drinkers exhibited levels of HDL cholesterol identical to those of subjects who did not drink wine.

Conclusion

The findings support the suggestion that regular intake of all types of alcoholic drinks is associated with a lower risk of major CHD

events. However, there was no evidence that regular drinking is associated with a lower risk of all-cause mortality than occasional drinking. Wine drinkers showed substantially lower risks of CHD and all-cause mortality than those consuming other types of alcohol. Adjustment for the many advantageous characteristics of wine drinkers has a marked effect on the relative risk of CHD incidence and all-cause mortality, suggesting that these characteristics are largely responsible for the apparent benefits of being a wine drinker. □

Contributors

S. G. Wannamethee and A. G. Shaper both contributed to design, analysis, and writing of the paper. Both authors are guarantors for the integrity of the research.

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